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Gulf of Alaska Coastal Research on Juvenile Salmon, August 2000

by

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Abstract

A research cruise was conducted by the Auke Bay Laboratory, Ocean Carrying Capacity program during August 2000 to study the early marine distribution, migration, and growth of juvenile salmon in the coastal waters of the Gulf of Alaska. Emphasis of the August cruise was placed on determining migratory pathways for juvenile salmon around Kodiak Island. Initial results based on average size of juvenile salmon indicate that juvenile salmon captured in Shelikof Strait may be from localized stocks near Kodiak Island. Future analysis of juvenile salmon otoliths for hatchery thermal marks and tissues using genetic stock identification techniques will shed additional light on the migratory pathways of juvenile salmon around Kodiak Island.

Introduction

During August 2000, scientists from the Auke Bay Laboratory, Ocean Carrying Capacity (OCC) program conducted a survey of juvenile salmon along the coastal waters of the Gulf of Alaska (GOA). The August 2000 survey was the fourth in a series of annual assessments (see Carlson et al. 1996-1998) to document variations in the biological characteristics (e.g. early marine growth, migration, and distribution) of juvenile salmon in the coastal GOA. These annual surveys (see Carlson et al. 2000 for summary) along with previous surveys (Hartt and Dell 1986) have documented that juvenile salmon from the Pacific Northwest, British Columbia, and Alaska migrate in a counter-clockwise direction along the continental shelf of the GOA.

The strong preference by juvenile salmon to remain over the continental shelf of the GOA as opposed to offshore waters is not fully understood. One of the major oceanographic features along the continental shelf of the GOA is the Alaska Coastal Current (ACC) which is a vigorous counter-clockwise current around the continental shelf and is the main transport of dissolved substances and plankton along the coastal GOA. It is possible that the ACC serves as essential habitat by providing a nurturing area for juvenile salmon. Availability of forage resources is one of the major factors in selection of habitat by juvenile salmon (Pearcy 1992), and the possibility of increased productivity in the coastal GOA may explain the fidelity of salmon to that habitat.

Previous surveys (for example Hartt and Dell 1986; Carlson et al. 1996-1998) sampled coastal waters around Kodiak Island, but neglected to sample juvenile salmon within Shelikof Strait. This may be an important migrating corridor for juvenile salmon since about 75% of the water transported by the ACC flows through Shelikof Strait (Stabeno et al. 1995; Royer 1998; Schumacher et al. 1989). Catch records from Carlson (1998), indicated that the largest catch of juvenile salmon during the 1998 survey occurred near the northeastern entrance to Shelikof Strait. Because of the possible importance of Shelikof Strait as a rearing area for juvenile salmon, and of the lack of sampling within Shelikof Strait during previous salmon surveys, the NMFS, OCC August 2000, GOA

survey objectives were: to determine the migration path of juvenile salmon around Kodiak Island (Shelikof Strait or seaward side of Kodiak Island); and to describe the physical environment of coastal waters used by migrating juvenile salmon in this region.

Methods

The OCC survey along the coastal waters of the Gulf of Alaska was conducted during August 8–19, 2000. The survey area included 5 transects west of Prince William Sound beginning with the Seward Line transect and ending at Cape Kekurnoi at the western end of Shelikof Strait (Figure 1). The cruise itinerary and participating scientists are listed in Tables 1 and 2. Transects sampled during the survey were perpendicular to shore and generally extended from nearshore across the continental shelf to oceanic waters beyond the 200 m shelf break. Sampling stations along each transect were generally spaced 18.5 km apart; each transect included a nearshore station (station less than 4 km from shore).

The survey was conducted aboard the contracted fishing vessel (F/V) *Great Pacific*. The vessel is a 38-m stern trawler with a main engine of 1450 horsepower and a cruising speed of 10 kts. Fish samples were collected using a midwater rope trawl, which is 198 m long, has hexagonal mesh in wings and body, and has a 1.2-cm mesh liner in the codend. The rope trawl was towed at 4 to 5 kts, at or near surface, and had a typical spread of 43.5 m horizontally and 12 m vertically. All tows lasted 30 minutes and covered 2.8 to 4.6 km. All sampling was done during daylight hours.

Salmon and other fishes were sorted by species and counted. Standard biological measurements including fork length, body weight, and sex as well as scale samples from the preferred area (to document age and growth) were taken from subsamples of all salmon species. Subsamples of juvenile pink, chum, and sockeye salmon were frozen whole for laboratory analyses of food habits, otolith hatchery thermal marks (pink and chum salmon), and genetic analysis (chum and sockeye salmon). Genetic tissues and otoliths were also saved from immature and maturing chum salmon to determine stock distribution and migration of these salmon. All other fish species were counted; juvenile rockfish and sablefish were frozen whole for laboratory analyses.

Oceanographic data were collected at each trawl station immediately prior to each trawl haul. Depth profiles of salinity and temperature from surface to near bottom depths were collected using a Sea-Bird SBE 19 Seacat profiler¹. Plankton samples² were collected using 60-cm diameter bongo samplers fitted with 505- and 333 μ m mesh nets, respectively. The bongo nets were towed obliquely from near surface to approximately 10 m from the bottom; estimated depth of each bongo tow was calculated by wire angle

¹ Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

² A cooperative agreement between NMFS OCC and the University of Alaska, Fairbanks to share plankton and salmon information along the Seward Line was put in place before the August 2000 survey. The University of Alaska collected plankton along the Seward Line aboard the R/V *Alpha Helix* using a MOCNESS sampler.

and length of wire. Volume of water filtered by each net was estimated by flow meters. Plankton samples were preserved in 5% formalin.

Results

During the survey, 5 transects were sampled and 31 trawl stations were completed beginning at the offshore end of the Seward Line (GAK) transect and ending at the southwestern end of the Shelikof Strait along Cape Kekurnoi (Figure 1; Table 3). Rough weather forced us to cancel two stations near the slope along Cape Chiniak. A total of 14,646 salmon representing 5 species were captured (Table 4). The largest component of the catch was juvenile salmon including pink (65%), chum (15%), sockeye (9%), coho (5%), and chinook (1%). Immature salmon in our catch included chum (2%), sockeye (<1%), and chinook (<1%). Maturing salmon in our catch included pink (2%), chum (4%), sockeye (<1%), coho (<1%), and chinook (<1%) salmon. Other species captured during the survey are listed in Table 5.

Salmon distribution within our survey varied depending on life history stage. Juvenile salmon were found within Shelikof Strait and along the continental shelf from nearshore locations to the 200 m shelf break (Figures 2a-d). The largest concentrations of juvenile salmon were found along the Seward Line; whereas the largest catch of juvenile salmon at any station occurred 130 km offshore of Gore Point. Immature salmon were mainly found west of the Seward Line transect in small numbers across the continental shelf (Figure 3a-c). The largest catch of immature chum salmon occurred at the offshore station on the Cape Chiniak transect. Only two immature chum salmon and one immature chinook salmon were caught within Shelikof Strait. Mature pink salmon were found along all transects sampled, with the largest catch occurring at the shelf station on the Cape Chiniak transect (Figure 4a). Maturing chum salmon were found in small numbers along the Gore Point transect (Figure 4b), whereas maturing coho salmon were found in small numbers along both Gore Point and the Seward Line transect (Figure 4c).

Body size of juvenile salmon varied depending on location (Table 6). Juvenile salmon were smaller along the Seward Line transect than along Gore Point. Within Shelikof Strait, juvenile salmon were smallest along the Cape Nukshak transect than the Cape Kekurnoi transect. In general, juvenile salmon captured within Shelikof Strait were smaller than salmon located at transects outside Shelikof Strait.

Sea surface temperatures were warmest at nearshore locations then decreased across the shelf and increased slightly near the outer margins of the 200 m shelf break (Table 3). The coolest sea surface temperatures were found within Shelikof Strait.

Discussion

To determine the migratory pathway of juvenile salmon around Kodiak Island we selected two transects east of Kodiak Island, one transect on the seaward side of Kodiak Island, and two transects within Shelikof Strait. Past surveys during August indicated that juvenile hatchery pink and chum salmon from Prince William Sound had migrated beyond these transects to areas westward of Kodiak Island (Farley and Munk 1997). We assumed therefore, that our survey would provide us with information on migratory pathways of salmon around Kodiak Island.

Past surveys of the coastal GOA found juvenile salmon were generally smaller near exit corridors than those found further along their migratory pathway (Hartt and Dell 1986, Carlson et al. 1996; Farley and Munk 1997). The Seward Line transect is near an exit corridor for juvenile salmon leaving Prince William Sound and the juvenile salmon caught along this transect were smaller than juvenile salmon captured along the Gore Point transect. Juvenile salmon captured within Shelikof Strait, however, were smaller than those captured at either the Seward Line or Gore Point transects, possibly indicating that juvenile salmon caught within Shelikof Strait may be from local stocks near Kodiak Island and not migratory salmon from other exit corridors east of Kodiak.

Past surveys have also showed that hatchery juvenile pink and chum salmon from Prince William Sound were located near the northern entrance to Shelikof Strait and near the 200 m slope along the Cape Chiniak transect (Farley and Munk 1997; Farley et al. 1999). Genetic and thermal mark analyses of data from our survey will help refine our understanding of the stock origins of salmon around Kodiak Island, and the migration pathway of hatchery salmon emigrating from Prince William Sound.

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Table 1. Cruise itinerary for the August 8 – 19, 2000 juvenile salmon survey in the coastal waters of the Gulf of Alaska.

Date	Location/Activity
8-August	Depart Dutch Harbor, enroute Seward Line
9-August	Enroute Seward Line
10-August	Enroute Seward Line
11-August	Begin sampling Seward Line
12-August	Continue sampling Seward Line; enroute Gore Point
13-August	Begin sampling Gore Point
14-August	Continue sampling Gore Point; enroute Cape Chiniak
15-August	Begin sampling Cape Chiniak; enroute Cape Nukshak
16-August	Begin sampling Cape Nukshak; enroute Cape Kekurnoi, begin sampling
17-August	Continue sampling Cape Kekurnoi; enroute Dutch Harbor
18-August	Enroute Dutch Harbor
19-August	Arrive Dutch Harbor, unload scientists

Table 2. Participating scientists for the August 8 – 19, 2000 juvenile salmon surveys in the coastal waters of the Gulf of Alaska.

Scientist	Agency
Edward V. Farley, Jr. (Chief Scientist)	Auke Bay Laboratory, AFSC, NMFS
Christine M. Kondzela	Auke Bay Laboratory, AFSC, NMFS
Ellen C. Martinson	Auke Bay Laboratory, AFSC, NMFS
Mary Auburn-Cook	Invert Inc., Susquehanna, PA
Jennifer Boldt	University of Alaska Fairbanks

Table 3. Haul information for the August 8 - 19, 2000 juvenile salmon survey in the Gulf of Alaska.

Date	Lat N	Lon W	Course	Start Time	Speed (Knots)	Vertical (m)	Horizontal (m)	Warp (m)	Habitat	SST
8/11	58.14	147.56	315	15:50	5.0	10.1	43.9	366	Oceanic	13.8
8/11	58.23	148.04	335	17:53	4.2	11.0	43.9	366	Oceanic	14.6
8/11	58.32	148.13	330	19:56	4.4	10.1	44.8	393	Oceanic	14.5
8/11	58.40	148.21	330	21:54	4.4	11.9	43.9	393	Slope	14.3
8/12	58.48	148.29	338	6:22	4.4	11.0	44.8	393	Slope	14.3
8/12	58.58	148.38	333	8:31	4.9	11.0	43.9	366	Slope	14.0
8/12	59.07	148.46	339	10:31	4.8	11.0	43.9	366	Slope	13.9
8/12	59.16	148.54	334	12:36	4.5	11.0	43.9	366	Shelf	14.1
8/12	59.24	149.02	333	14:36	4.4	11.9	43.9	366	Shelf	13.9
8/12	59.33	149.11	333	16:38	4.4	11.9	43.9	348	Shelf	14.1
8/12	59.41	149.20	335	18:35	3.8	12.8	43.0	366	Shelf	15.0
8/12	59.50	149.28	333	20:55	4.5	11.0	43.9	366	Nearshore	14.9
8/13	59.10	150.56	135	0:00	5.2	12.8	43.9	339	Nearshore	14.2
8/13	59.02	150.51	135	9:27	4.6	13.7	42.1	366	Shelf	13.9
8/13	58.53	150.44	135	11:49	4.4	11.0	43.9	366	Shelf	12.7
8/13	58.44	150.38	135	15:06	4.3	12.8	43.9	366	Shelf	13.2
8/13	58.35	150.27	140	7:07	5.0	11.0	43.9	366	Shelf	12.1
8/14	58.25	150.19	150	6:16	6.1	11.9	43.9	366	Shelf	12.2
8/14	58.16	150.16	152	8:50	4.4	12.8	43.9	366	Shelf	12.0
8/14	58.07	150.09	155	12:23	2.4	13.7	42.1	366	Slope	12.6
8/14	57.58	149.55	155	16:33	5.1	11.9	43.9	366	Slope	12.9
8/14	57.50	149.47	155	19:24	5.3	12.8	43.9	366	Slope	12.2
8/15	57.00	150.42	145	7:07	4.3	13.7	42.1	366	Oceanic	13.8
8/15	57.22	151.31	175	17:02	4.4	11.9	44.8	366	Shelf	11.1
8/15	57.33	151.54	330	21:30	4.4	12.8	42.1	366	Shelf	10.6
8/16	58.03	153.27	320	7:25	4.1	11.0	43.9	366	Nearshore	12.6
8/16	58.11	153.41	325	9:45	4.0	11.0	43.9	366	Shelf	12.1
8/16	58.22	153.56	145	12:26	4.6	11.0	43.9	366	Nearshore	12.1
8/16	57.42	155.17	130	19:12	4.1	10.1	45.8	366	Nearshore	11.6
8/17	57.35	155.03	125	7:53	4.6	11.0	42.1	366	Shelf	11.4
8/17	57.26	154.46	315	11:05	4.2	13.7	40.3	339	Nearshore	11.2

Table 4. Total catch of juvenile (J), immature (I), and adult (A) salmon by species and location by the F/V *Great Pacific* in the Gulf of Alaska during August 8 - 19, 2000. Dash (-) indicates no salmon caught.

Date	Lat N	Lon W	Pink		Chum			Sockeye			Coho		Chinook		
			J	A	J	I	A	J	I	A	J	A	J	I	A
8/11	58.14	147.56	-	-	-	-	-	-	-	-	-	-	-	-	-
8/11	58.23	148.04	-	-	-	-	-	-	-	-	1	-	-	-	-
8/11	58.32	148.13	-	-	-	-	-	-	-	-	-	1	-	-	-
8/11	58.40	148.21	-	-	-	5	-	-	-	-	2	-	-	-	-
8/12	58.48	148.29	-	-	-	-	-	-	-	-	-	-	-	-	-
8/12	58.58	148.38	2	6	-	1	-	-	-	-	4	1	-	1	-
8/12	59.07	148.46	1020	1	92	1	-	54	-	-	20	2	-	-	-
8/12	59.16	148.54	710	4	135	-	-	42	-	-	196	1	-	-	-
8/12	59.24	149.02	143	9	26	-	-	13	-	-	15	1	-	-	-
8/12	59.33	149.11	600	-	112	-	-	11	-	-	26	2	1	-	-
8/12	59.41	149.20	640	68	130	2	-	98	-	-	10	1	1	-	-
8/12	59.50	149.28	43	6	90	-	-	4	-	-	13	-	-	-	-
8/13	59.10	150.56	590	2	140	-	-	130	-	-	50	-	-	-	-
8/13	59.02	150.51	28	-	22	-	20	110	-	-	62	3	-	23	-
8/13	58.53	150.44	150	6	62	20	3	51	-	-	49	-	-	6	2
8/13	58.44	150.38	171	-	32	15	2	65	1	-	58	2	-	14	-
8/13	58.35	150.27	110	10	33	4	1	50	-	-	69	2	-	2	-
8/14	58.25	150.19	108	2	48	6	4	17	-	-	6	2	-	1	-
8/14	58.16	150.16	76	8	48	1	6	10	-	-	-	1	-	-	-
8/14	58.07	150.09	3030	6	410	4	4	95	1	-	20	1	-	2	-
8/14	57.58	149.55	174	9	17	-	2	1	1	-	4	1	-	1	-
8/14	57.50	149.47	480	15	33	13	2	4	2	-	-	1	-	2	-
8/15	57.00	150.42	-	-	-	450	-	-	-	-	-	-	-	-	-
8/15	57.22	151.31	273	73	28	5	1	15	-	-	2	-	-	-	-
8/15	57.33	151.54	280	13	18	1	-	6	-	-	7	7	-	2	-
8/16	58.03	153.27	126	4	153	2	-	155	-	-	20	-	-	1	-
8/16	58.11	153.41	97	6	123	-	-	27	-	-	4	-	-	-	-
8/16	58.22	153.56	260	-	87	-	-	60	-	-	12	-	-	-	2
8/16	57.42	155.17	119	36	108	-	5	100	-	3	51	2	-	-	-
8/17	57.35	155.03	230	28	160	-	-	132	-	1	6	-	-	-	-
8/17	57.26	154.46	58	5	27	-	-	9	-	-	29	1	-	-	-

Table 5. Total catch of marine fishes by species and location by the F/V *Great Pacific* in the Gulf of Alaska during August 8 - 19, 2000. Dash (-) indicates no marine fish caught.

Date	Lat N	Lon W	Herring	Capelin	Sand-lance	Wolfeel	Pom-fret	Prow-fish	Crested Sculpin	Sable-fish	J.Rock-fish	3-spine Stick
8/11	58.14	147.56	-	-	-	-	-	-	-	-	731	-
8/11	58.23	148.04	-	-	-	-	-	-	-	-	1,000	-
8/11	58.32	148.13	-	-	-	-	-	-	-	-	1,000	300
8/11	58.40	148.21	-	-	-	-	1	1	-	-	400	3
8/12	58.48	148.29	-	-	-	-	-	-	-	-	180	-
8/12	58.58	148.38	-	-	-	1	-	-	-	20	150	-
8/12	59.07	148.46	-	-	-	-	-	2	-	-	-	-
8/12	59.16	148.54	-	-	-	-	-	-	-	-	-	-
8/12	59.24	149.02	1	1	-	-	-	1	-	-	-	-
8/12	59.33	149.11	-	2	-	-	-	-	-	-	-	-
8/12	59.41	149.20	2	-	-	-	-	-	-	-	-	-
8/12	59.50	149.28	1	-	-	-	-	2	-	-	-	-
8/13	59.10	150.56	1	-	-	-	-	2	-	-	-	-
8/13	59.02	150.51	1	1	-	-	-	-	-	-	-	-
8/13	58.53	150.44	4	-	-	-	-	-	-	1	-	-
8/13	58.44	150.38	7	-	-	-	-	-	-	-	-	-
8/13	58.35	150.27	6	-	-	-	-	1	-	-	-	-
8/14	58.25	150.19	1	-	1,000	-	-	1	-	-	-	-
8/14	58.16	150.16	-	18	-	-	-	5	-	-	-	-
8/14	58.07	150.09	1	2	13	-	-	1	-	-	-	-
8/14	57.58	149.55	-	-	-	-	-	2	-	13	1	-
8/14	57.50	149.47	1	-	-	-	-	-	-	4	-	-
8/15	57.00	150.42	-	-	-	-	-	-	-	-	-	-
8/15	57.22	151.31	-	-	-	-	-	2	-	-	-	-
8/15	57.33	151.54	136	-	1,000	-	-	-	-	-	-	-
8/16	58.03	153.27	6	1	-	-	-	2	-	-	-	-
8/16	58.11	153.41	-	-	-	-	-	-	-	-	-	-
8/16	58.22	153.56	4	1	-	-	-	2	-	-	-	-
8/16	57.42	155.17	4	-	1	-	-	-	-	-	-	-
8/17	57.35	155.03	52	-	-	-	-	-	-	-	-	-
8/17	57.26	154.46	-	-	-	-	-	5	5	-	-	-

Table 5. (Con't) Total catch of marine fishes by species and location by the F/V *Great Pacific* in the Gulf of Alaska during August 8 - 19, 2000. Dash (-) indicates no marine fish caught.

Date	Lat N	Lon W	Dogfish	Pollock		Juv. P. Cod	Squid	Salmon Shark	Sand- fish	Eula- chon
				J	A					
8/11	58.14	147.56	-	-	-	-	-	-	-	-
8/11	58.23	148.04	-	-	-	-	-	-	-	-
8/11	58.32	148.13	-	-	-	-	14	-	-	-
8/11	58.40	148.21	-	-	-	-	2,000	-	-	-
8/12	58.48	148.29	-	-	-	-	-	-	-	-
8/12	58.58	148.38	-	-	-	-	-	-	-	-
8/12	59.07	148.46	7	-	1	-	-	-	-	-
8/12	59.16	148.54	2	-	-	-	-	-	-	-
8/12	59.24	149.02	1	-	-	-	-	-	-	-
8/12	59.33	149.11	1	-	-	-	-	-	-	-
8/12	59.41	149.20	-	-	1	-	-	-	-	-
8/12	59.50	149.28	-	-	-	-	-	-	-	-
8/13	59.10	150.56	-	1	-	-	-	-	-	14
8/13	59.02	150.51	305	-	-	-	-	-	-	-
8/13	58.53	150.44	-	-	-	-	-	-	-	-
8/13	58.44	150.38	-	-	-	-	-	-	-	-
8/13	58.35	150.27	-	-	6	-	-	-	-	-
8/14	58.25	150.19	91	-	-	-	-	-	-	-
8/14	58.16	150.16	-	1	-	-	2	-	-	-
8/14	58.07	150.09	-	-	-	-	-	-	-	-
8/14	57.58	149.55	-	-	-	-	-	-	-	-
8/14	57.50	149.47	-	-	-	-	-	-	-	-
8/15	57.00	150.42	-	-	-	-	-	-	-	-
8/15	57.22	151.31	-	-	-	-	-	-	-	3
8/15	57.33	151.54	-	-	-	-	-	-	-	1,000
8/16	58.03	153.27	-	-	-	-	-	-	2	-
8/16	58.11	153.41	-	-	-	-	-	-	-	-
8/16	58.22	153.56	-	-	-	-	-	-	3	-
8/16	57.42	155.17	-	-	-	-	-	1	-	-
8/17	57.35	155.03	-	-	-	-	-	-	-	-
8/17	57.26	154.46	-	100	4	500	-	-	38	-

Table 6. Average length and weight by transect of juvenile pink, chum, sockeye, and coho salmon captured by the F/V *Great Pacific* in the Gulf of Alaska during August 8 - 19, 2000. Asterick (*) indicates no length or weight taken for juvenile salmon during cruise; salmon were frozen and brought back to laboratory for analysis.

Transect	Pink					Chum					Sockeye					Coho				
	Length			Weight		Length			Weight		Length			Weight		Length			Weight	
	<i>n</i>	Ave	Std	Ave	Std	<i>n</i>	Ave	Std	Ave	Std	<i>n</i>	Ave	Std	Ave	Std	<i>n</i>	Ave	Std	Ave	Std
Seward Line	146	177.1	24.7	59.4	26.5	136	169.1	25.8	53.8	29.0	32	187.8	24.5	73.9	34.1	96	279.2	28.3	280.0	88.7
Gore Point	105	198.3	28.0	80.4	27.6	85	202.1	32.6	95.0	43.2	37	223.5	32.0	131.9	58.2	100	302.5	19.9	374.7	82.8
Cape Chiniak	60	*	*	*	*	46	*	*	*	*	21	*	*	*	*	9	273.1	57.0	308.0	166.9
Cape Nukshak	56	138.7	23.6	25.0	21.4	65	130.0	25.4	25.0	21.0	42	154.5	43.1	48.0	43.2	24	190.8	51.3	105.3	120.5
Cape Kekurnoi	30	149.7	25.7	33.1	23.1	30	145.9	23.2	34.6	17.0	29	155.0	44.0	50.9	50.2	29	229.1	34.8	157.5	83.8

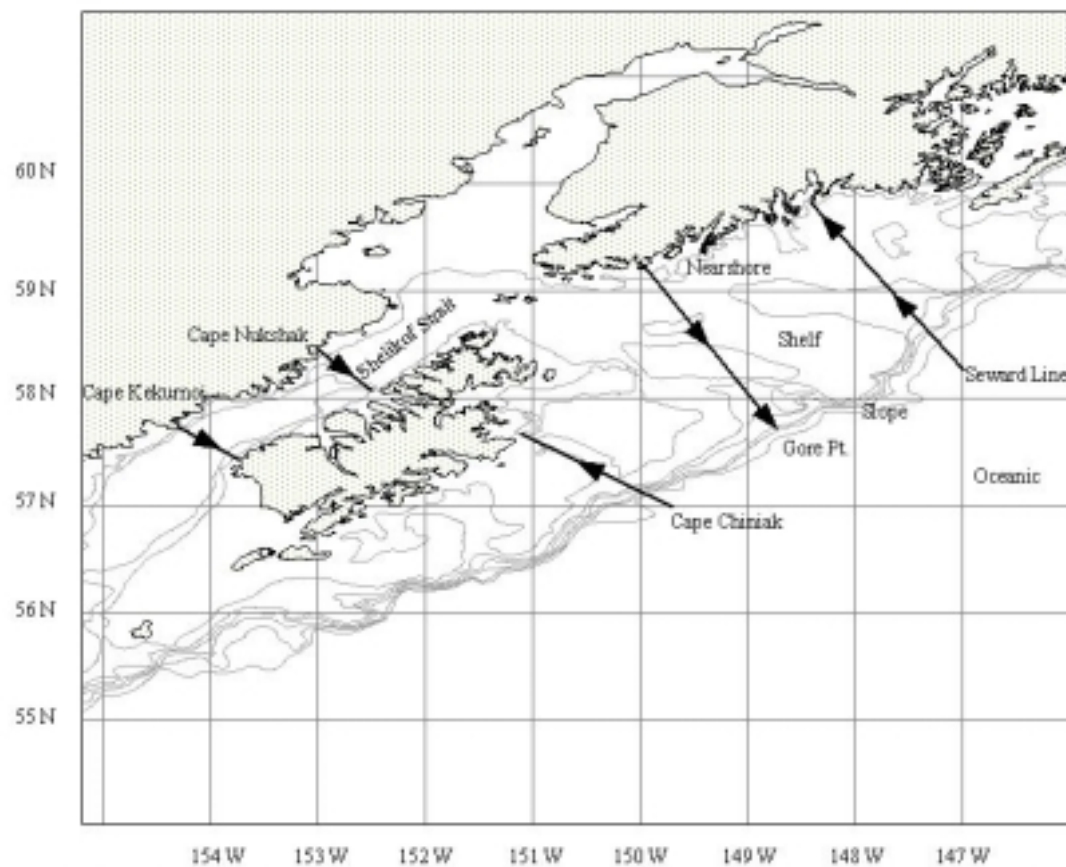


Figure 1. Transects (Dark lines) sampled by the NMFS, OCC program in the Gulf of Alaska August 8 - 19, 2000. Habitat is defined as Oceanic (beyond the slope in oceanic waters), Slope (200 m contour), Shelf (continental shelf), and Nearshore.

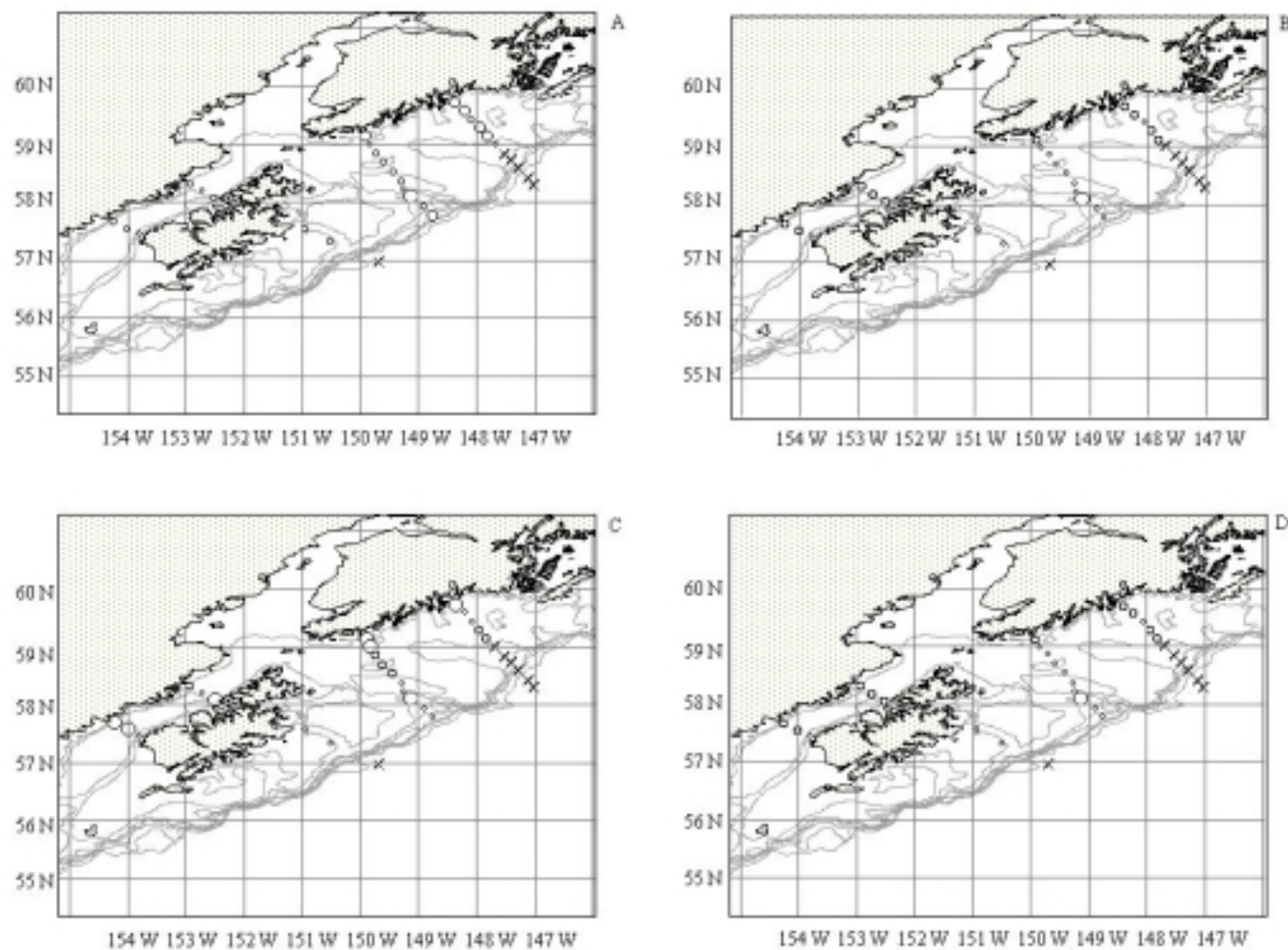


Figure 2. Distribution of juvenile pink (A), chum (B), sockeye (C), and coho (D) salmon captured by the F/V Great Pacific during August 8 - 19, 2000 in the Gulf of Alaska. Circles (O) indicate sampling stations where juvenile salmon were caught; larger circles indicate greater catch (see Table 4 for actual numbers caught at each station). X indicates sampling stations where no juvenile salmon were caught.

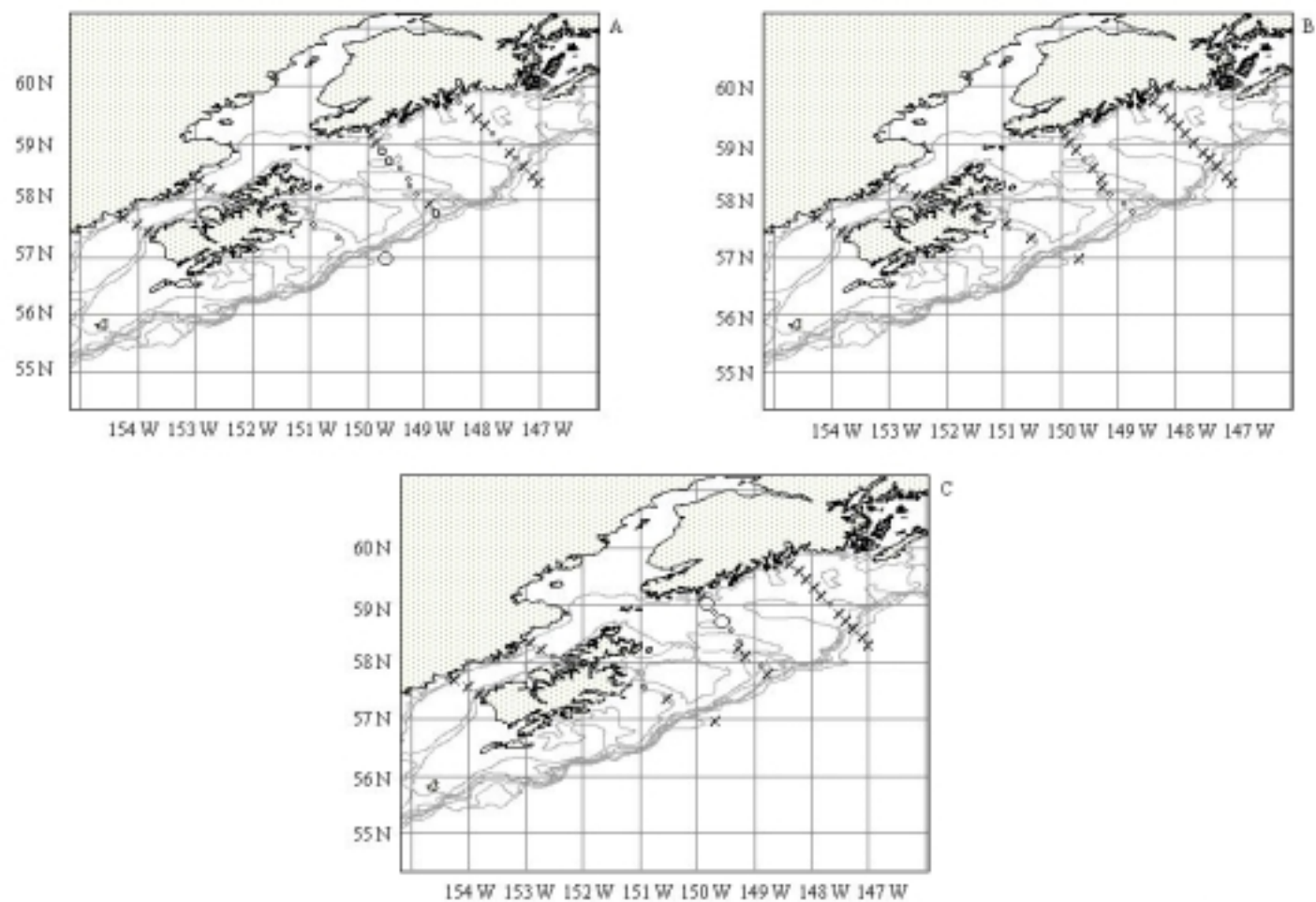


Figure 3. Distribution of immature chum (A), sockeye (B), and chinook (C) salmon captured by the F/V Great Pacific during August 8-19, 2000 in the Gulf of Alaska. Circles (O) indicate sampling stations where immature salmon were caught; larger circles indicate greater catch (see Table 4 for actual numbers caught at each station). X indicates sampling stations where no immature salmon were caught.

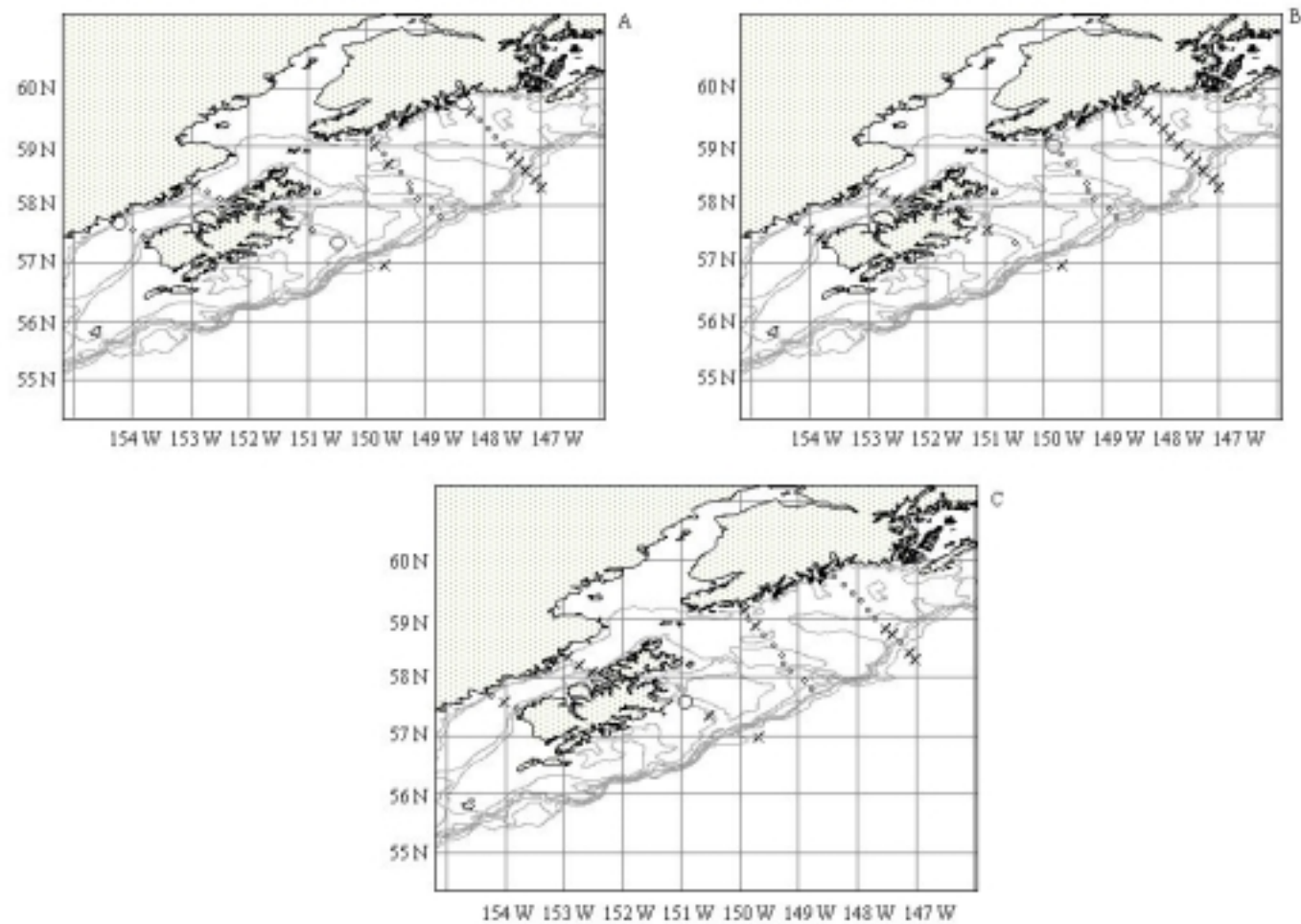


Figure 4. Distribution of maturing pink (A), chum (B), and coho (C) salmon captured by the F/V Great Pacific during August 8 -19, 2000 in the Gulf of Alaska. Circles (O) indicate sampling stations where maturing salmon were caught, larger circles indicate greater catch (see Table 4 for actual numbers caught at each station). X indicates sampling stations where no maturing salmon were caught.